REMARKS

This Supplemental Amendment is submitted to supplement the Amendment filed on February 7, 2007 and is consistent with the discussion at the personal interview with Examiner Janell Combs Morillo on April 11, 2007. This Supplemental Amendment and the following remarks take into consideration the issues discussed in the Office Action mailed August 8, 2006 wherein the Examiner rejected claims 1-26, all the claims in the application. An initial Amendment and Declaration of Roberto J. Rioja was submitted in response to the Office Action on February 7, 2007. Reconsideration of the application based on the discussion at the personal interview, the accompanying amendments, the Supplemental Declaration of Roberto J. Rioja and the following remarks is respectfully requested.

Prior to discussing the amendments presented herewith, applicants and the undersigned take this opportunity to thank Examiner Morillo for the time consideration and cooperation offered to Dr. Rioja and the undersigned during the interview on April 11, 2007. At the interview, the undersigned presented a suggested amendment to claim 1. Dr. Rioja reviewed the surprising and unexpected benefits achieved by his novel alloys and discussed the remarkable properties of the alloys in several PowerPoint slides which have been simplified somewhat and incorporated into his Supplemental Declaration.

As noted on the Interview Summary, agreement with respect to the claims was not reached. However, the prior art to Pickens, U.S. Patent No. 5,455,003 and Rioja, Nos. 5,137,686 was reviewed in depth. The Examiner did acknowledge that the improved strength/toughness relationship achieved by applicants is indeed surprising and needs to be recited in the claim. The Amendment set forth here was suggested and does just that. In view of this, applicants respectfully submit that the amended claims truly define their invention and are in condition for immediate allowance.

Dr. Rioja explained several reasons in support of patentability of the claims. Specifically, he emphasized that the new Al-Cu-Mg-Li alloys claimed contain up to about 0.8 weight percent lithium and exhibit an improved strength/toughness relationship which is inconsistent with the extensive teachings in the technical literature. He also explained that several significant alloy properties measured on experimental plate and sheet samples show performance superior to other products currently in wide use for lower wing skins and fuselage applications in the aerospace industry today.

It was the Examiner's position that the benefits submitted would be demonstrated for the range set forth in the claim and that the benefit should be recited. In view of this, applicants have amended independent claims 1, 25 and 26 to recite that the strength/toughness relationship for the claimed alloy is positive for the lithium additions to a given alloy. Applicants respectfully submit that this benefit is not shown or suggested in the prior art. The positive strength/toughness relationship is supported by the data set forth in the application in Example 1 and shown in graphical form in FIG. 5. The data in Example 2 provides further support for different alloys not including silver in alloys B, C and D compared to alloy A. These comparative results are shown in graphical illustration at different aging conditions in FIG. 6 and for specific tensile yield strength in FIG. 7.

In sum, the benefit discovered by applicants is the positive strength/toughness relationship. This has been recited in all the claims in the application. Accordingly, applicants respectfully submit that by this recitation, the claims distinguish over the prior art and are indeed patentable. The application should be allowed. Turning now to the prior art rejection in the August 8, 2006 Office Action, the Examiner rejected claims 1-15 and 18-25 under 35 U.S.C. § 103(a) as obvious over Pickens, U.S. Patent No. 5,455,003. The Examiner bases this rejection on Pickens' teaching of an aluminum alloy including 2.8-4.8% Cu, 0.4-1.5% Li, 0.2-1.05 Mg, a grain refiner, and up to 0.8% Ag, or up to 1.05 Zn. The Examiner considers this to substantially overlap the presently claimed alloy range as well as Example Q and Table 2, column 6 that is close to the alloy range of the claims. Examiner considers this substantial overlap to create a *prima facie* case of obviousness.

With respect to the solubility limitation, the Examiner also considers Pickens to teach Cu and Mg below the solubility limit of the alloy. The Examiner recognizes that Pickens does not specify fatigue or crack growth resistance, but considers that in view of the overlap that Pickens' alloy would have substantially the same properties. The Examiner also notes that Pickens teaches that the alloy can be in the form of a sheet, plate, extrusion or forging.

Claims 16, 17 and 26 were rejected over Pickens '003 in view of Rioja et al., U.S. No. 5,137,686. The Examiner acknowledges that Pickens does not mention 0.1-2% Si or 0.3-1% Si, however Rioja '686 teaches that 0.5% max Si is typically present in similar Al-Cu-Li-Mg alloys. The Examiner concludes that because both Pickens and Rioja are directed to similar alloys for aerospace applications, Pickens teaches that the alloys are suitable for high strength/toughness applications, citing column 1, lines 38-40.

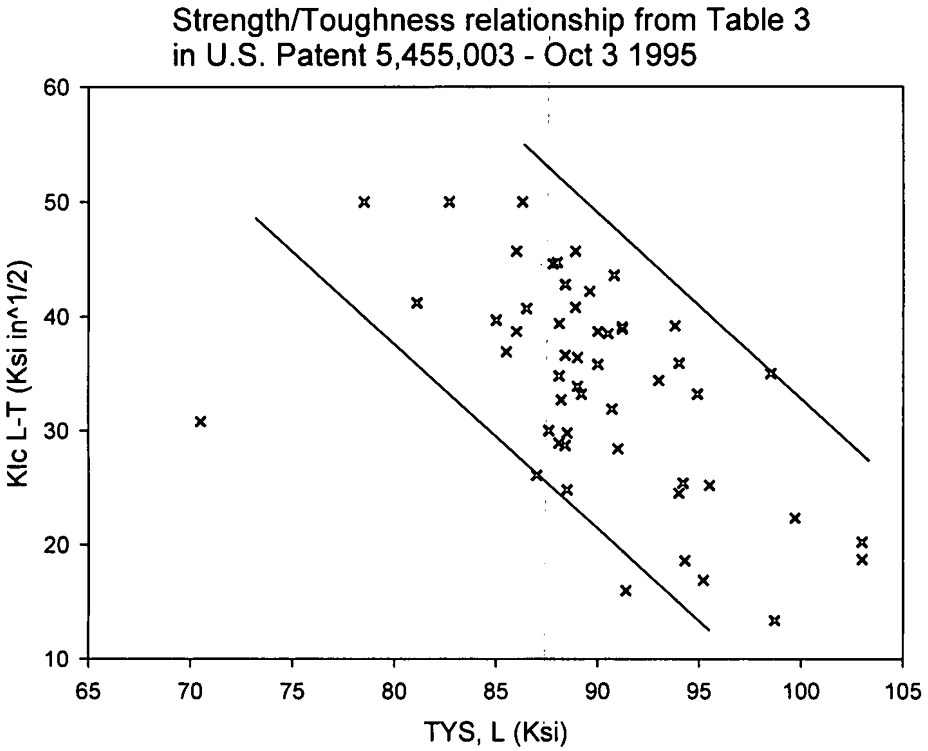
Both rejections are respectfully traversed for the reasons set forth herein and in the original Declaration of Roberto J. Rioja and the Supplemental Declaration submitted herein and the discussion at the personal interview. Since the rejections of claims 1-15 and 18-25 are based solely on Pickens '003 and that of claims 16, 17-20 are based principally on Pickens '003 in view of Rioja '686, applicants respectfully submit that upon removal of Pickens '003 as an effective reference under Section 103, both rejections should be withdrawn.

The prima facie case of obviousness can be overcome by a showing of surprising results. In view of the well accepted view that there is an inverse relationship between strength and toughness, and applicants' discovery that for lithium addition up to about 0.80 weight %, there is a positive relationship is that surprising result. Thus, the prima facie case of obviousness has been overcome.

The Examiner has agreed with applicants in the Office Action and at the interview that there is an inverse relationship between yield strength and strength. The data in Pickens '003 were discussed in general. It was noted that Pickens generally teaches a higher lithium content then claimed with lower magnesium levels for similar ranges of copper. Pickens does this to obtain higher fracture toughness at low temperatures. The focus in Pickens is directed to its end use at cryogenic temperatures, for example in cryogenic tanks for space launch vehicles and the like.

It was pointed out to the Examiner that the combination of properties of the claimed alloys not only present a positive strength/toughness relationship, but are better than that available in the current state of the art.

The lithium additions in Pickens '003, as shown in the Declaration of Roberto J. Rioja are presented in graphical form in paragraph 7. This is a plot of Pickens' yield strength versus toughness using the data reported by Pickens at Table 3, columns 15-18. This graph is repeated below.



This graph confirms the well accepted inverse relationship between yield strength and toughness. This data demonstrate that as a general rule for Al-Cu-Mg-Li alloys under review, as strength is increased, the toughness decreases. The Examiner concurs that Pickens as well as the prior art teach this inverse relationship between yield strength and toughness and that an increase in yield strength and toughness -- a direct relationship-- is unexpected. Applicants respectfully submit that they have demonstrated this unexpected result of a positive relationship between toughness and strength for additions of up to about 0.8 weight percent lithium to comparable alloys.

FIG. 5 of the application illustrates the increasing relationship of toughness and strength for alloys in Example 1. Also shown is a significantly lower values for both toughness and longitudinal yield strength for AA2524 -- the current standard and state of the art alloy for fuselage applications. A spider chart shown to the Examiner illustrating the benefits of the claimed lithium alloys was show to the Examiner during the interview. This is annexed as Exhibit D to the Supplemental Declaration of Roberto J. Rioja. As shown in Exhibit D, AA2524 and six physical properties are shown in the black hexagon. The comparable properties of another lithium alloy, AA2199, and an alloy (identified as (C14E) within the definition of claim 1 are shown as a ratio compared to AA2524. The AA2199 alloy include about 1.6% Li is shown in blue, and the alloy commensurate with the claim including about 0.75% Li is shown in red.

The properties are reported as ratio of the alloy property compared to AA 2524. These properties include the density; Fty LT -- the minimum tensile yield strength measured in the transverse direction; Ftu LT --the minimum ultimate tensile strength in the same direction; Et the tensile modulus longitudinal stress and measured with the transverse direction; Kapp T-L --the fracture toughness measuring resistance to propagation of a crack in the longitudinal direction; and FCG T-L the fatigue crack growth characteristic measuring the propagation of a crack in the longitudinal direction under repeated transverse stress.

As shown in Exhibit D, the claimed alloy is more dense than the AA 2199, given the lower Li content, but the minimum tensile yield and ultimate tensile strength and fractured toughness are significantly improved. This is truly unexpected.

The same improvements can be seen when the alloys prepared in accordance with the invention are compared to AA 2324-T39, the baseline and state of the art alloy for lower wing plate alloys. Here, Exhibit E to the Supplemental Declaration of Roberto J. Rioja shows in the black hexagon six physical properties for AA2324-T39. The physical properties measured here include density; Ftu L -- the minimum ultimate tensile strength Fty L-- the minimum tensile yield strength, -- the DK the fatigue crack growth rate stress intensity; and Et l (typ) the tensile modulus with stress applied in the longitudinal direction.

These reported properties in Exhibit E show that the strength/toughness relationship is positive for the claimed range. Obtaining this relationship is unexpected in light of the teachings in the art including Staley, annexed to the Declaration of Roberto J. Rioja as Exhibit 3. The experimental results reported in Exhibit D and E demonstrate superior performance compared to for a number of properties the state of the art presently utilized in lower wing skin and fuselage applications.

In the application at paragraph 0037, applicants note that lithium additions in the amount of about 1.5 weight percent and above result in the formation of the δ' phase having a composition of Al_3Li. This Al_3Li phase is avoided in alloy compositions prepared in accordance with the invention.

Dr. Rioja explained that there is extensive literature teachings that the δ' phase is necessary for improved fracture crack resistance and if this phase is avoided the fracture growth resistance is poor. Dr. Rioja exhibited electron microscope photographs showing aluminum lithium alloys with good fracture growth resistance showing presence of the δ' phase. This photograph is annexed to the Supplemental Declaration of Roberto J. Rioja as Exhibit C. The delta time phase is shown as the small white dots. Exhibit B is an enlargement of that photograph showing the T1 streaks and δ' phase as larger seals.

The photographs in Exhibit C for the alloy prepared in accordance with the invention show the T1 spots shown in the higher lithium content alloy, but without the presence of the δ'. This fact combined with the noted improvement in physical properties as exhibited by Exhibits D and E is indeed a surprising result.

It is also well accepted that artificial aging degrades the fatigue crack propagation resistance of 2000 series aluminum alloys. However, in the case of Al-Cu-Mg-Li alloys prepared in accordance with the invention, this degradation in fatigue crack propagation resistance does not occur. In fact, as shown in Exhibits D and E, the damaged tolerant properties are superior to both AA2524 utilized in fuselage structures and AA2324 utilized for lower wing plates. Both these latter alloys being the accepted state of the art. These results are again surprising and unexpected.

Applicants respectfully submit that this additional data set forth in the Supplemental Declaration of Roberto J. Rioja and the results set forth in the application, particularly in FIGS 5-7 fully demonstrate the unexpected result over the range claimed. This unexpected result is the positive strength/toughness relationship now recited in the independent claims. Accordingly, the Examiner is respectfully requested to reconsider the application in light of the reasons set forth herein and this additional data and withdraw the rejection over Pickens '003.

Applicants have made a sincere effort to address all the concerns expressed by the Examiner. It is respectfully submitted that the amendment to independent claims 1, 25 and 26 address the specific benefit unexpectantly observed by applicants, namely that the strength/toughness relationship is positive for lithium additions up to about 0.8% for a given alloy. In view of this, the Examiner is respectfully requested to reconsider the application at an early date with a view towards issuing a favorable action thereon. If upon review of the application, the Examiner is unable to issue an immediate Notice of Allowance, the Examiner is respectfully requested to telephone the undersigned attorney with a view towards resolving any outstanding issues.

Early and favorable action is earnestly solicited.

Respectfully submitted,
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